

WHAT IS CLAIMED IS:

1. A liquid crystal display device, comprising:

a first substrate having an inner surface and an outer surface;

a second substrate having an inner surface and an outer surface, wherein the inner

5 surface of the second substrate faces and is spaced apart from the inner surface of the first substrate;

a first polarizing film arranged on the outer surface of the first substrate;

a layer of liquid crystal material arranged between the first and second substrates;

a backlight unit proximate the outer surface of the second substrate; and

10 a cholesteric liquid crystal polarizing film arranged between the second substrate and the backlight unit, wherein the cholesteric liquid crystal polarizing film includes a first portion adjacent the backlight unit, a second portion adjacent the outer surface of the second substrate, and a third portion between the first and second portions, wherein the first portion includes a first pitch, wherein the second portion includes a second pitch, wherein the third
15 portion includes a third pitch, wherein a value of the third pitch is between values of the first and second pitches.

2. The device according to claim 1, wherein the first pitch is greater than the second pitch.

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3. The device according to claim 1, further comprising a cholesteric liquid crystal color filter layer arranged on the inner surface of the second substrate.

4. The device according to claim 3, wherein the cholesteric liquid crystal color filter layer reflects light having a polarization state that is opposite light reflectable by the cholesteric liquid crystal polarizing film.

5. The device according to claim 4, wherein
the cholesteric liquid crystal color filter layer reflects left-handed circularly polarized light; and
the cholesteric liquid crystal polarizing film reflects right-handed circularly polarized light.

6. The device according to claim 4, wherein
the cholesteric liquid crystal color filter layer reflects right-handed circularly polarized light; and
the cholesteric liquid crystal polarizing film reflects left-handed circularly polarized light.

7. The device according to claim 3, wherein
each of the first and second substrates include red, green, and blue pixel regions;
a portion of the cholesteric liquid crystal color filter layer arranged in the red pixel region transmits a red light;
a portion of the cholesteric liquid crystal color filter layer arranged in the green pixel region transmits a green light; and

a portion of the cholesteric liquid crystal color filter layer arranged in the blue pixel region transmits a blue light.

8. The device according to claim 7, wherein

5 the cholesteric liquid crystal color filter layer includes a first cholesteric liquid crystal layer and a second cholesteric liquid crystal layer;

a portion of the first cholesteric liquid crystal layer arranged within the red pixel region has a pitch for reflecting green light;

10 a portion of the second cholesteric liquid crystal layer arranged within the red pixel region has a pitch for reflecting blue light;

a portion of the first cholesteric liquid crystal layer arranged within the green pixel region has a pitch for reflecting blue light;

a portion of the second cholesteric liquid crystal layer arranged within in the green pixel region has a pitch for reflecting red light;

15 a portion of the first cholesteric liquid crystal layer arranged within the blue pixel region has a pitch for reflecting red light; and

a portion of the second cholesteric liquid crystal layer arranged within the blue pixel region has a pitch for reflecting green light.

20 9. The device according to claim 1, further comprising a retardation film arranged between the first polarizing film and the liquid crystal layer.

10. The device according to claim 9, wherein the liquid crystal layer has an optically compensated birefringence (OCB) mode.

11. The device according to claim 1, further comprising:

5 a retardation film arranged on the inner surface of the second substrate; and
a second polarizing film arranged on the retardation film.

12. The device according to claim 11, wherein light is linearly polarizable by the first and second polarizing films.

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13. The device according to claim 11, further comprising a cholesteric liquid crystal color filter layer arranged between the retardation film and the second substrate.

14. The device according to claim 13, wherein the liquid crystal layer has a
15 twisted nematic (TN) mode.

15. The device according to claim 13, wherein the retardation film and the second polarizing film are arranged on the cholesteric liquid crystal color filter layer.

20 16. The device according to claim 13, wherein the cholesteric liquid crystal color filter layer reflects light having a polarization state that is opposite light reflectable by the cholesteric liquid crystal polarizing film.

17. The device according to claim 16, wherein
the cholesteric liquid crystal color filter layer reflects left-handed circularly polarized
light; and

the cholesteric liquid crystal polarizing film reflects right-handed circularly polarized
5 light.

18. The device according to claim 16, wherein
the cholesteric liquid crystal color filter layer reflects right-handed circularly
polarized light; and

10 the cholesteric liquid crystal polarizing film reflects left-handed circularly polarized
light.

19. The device according to claim 18, wherein
each of the first and second substrates include red, green, and blue pixel regions;
15 a portion of the cholesteric liquid crystal color filter layer arranged in the red pixel
region transmits a red light;

a portion of the cholesteric liquid crystal color filter layer arranged in the green pixel
region transmits a green light; and

a portion of the cholesteric liquid crystal color filter layer arranged in the blue pixel
20 region transmits a blue light.

20. The device according to claim 19, wherein
the cholesteric liquid crystal color filter layer includes a first cholesteric liquid crystal

layer and a second cholesteric liquid crystal layer;

a portion of the first cholesteric liquid crystal layer arranged within the red pixel region has a pitch for reflecting green light;

5 a portion of the second cholesteric liquid crystal layer arranged within the red pixel region has a pitch for reflecting blue light;

a portion of the first cholesteric liquid crystal layer arranged within the green pixel region has a pitch for reflecting blue light;

a portion of the second cholesteric liquid crystal layer arranged within in the green pixel region has a pitch for reflecting red light;

10 a portion of the first cholesteric liquid crystal layer arranged within the blue pixel region has a pitch for reflecting red light; and

a portion of the second cholesteric liquid crystal layer arranged within the blue pixel region has a pitch for reflecting green light.

15 21. A liquid crystal display, comprising:

a first substrate having an inner surface and an outer surface;

a second substrate having an inner surface and an outer surface, wherein the inner surface of the second substrate faces and is spaced apart from the inner surface of the first substrate;

20 a cholesteric liquid crystal color filter layer arranged on the inner surface of the second substrate;

a backlight unit proximate the outer surface of the second substrate;

a cholesteric liquid crystal polarizing film having a first portion adjacent the backlight

unit and a second portion adjacent the outer surface of the second substrate, wherein

the first portion has a first helical pitch, wherein the second portion has a second
helical pitch, different from the first helical pitch; and

the cholesteric liquid crystal color filter layer reflects light having a polarization state
5 that is opposite light reflectable by the cholesteric liquid crystal polarizing film.

22. The liquid crystal display according to claim 21, wherein the first pitch is
greater is greater than the second pitch.

10 23. The liquid crystal display according to claim 21, wherein the cholesteric liquid
crystal polarizing film further includes a third portion adjacent the first and second portions.

24. The liquid crystal display according to claim 23, wherein the third portion has
a third helical pitch, intermediate the first and second helical pitches.

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25. The liquid crystal display according to claim 21, wherein the cholesteric liquid
crystal polarizing film has an ordinary refractive index of about 1.5.

26. The liquid crystal display according to claim 21, wherein the cholesteric liquid
20 crystal polarizing film has an extra-ordinary refractive index of about 1.68.

27. The liquid crystal display according to claim 21, wherein the cholesteric liquid
crystal polarizing film has thickness of about 30 μm .

28. The liquid crystal display according to claim 21, wherein
the cholesteric liquid crystal color filter layer reflects left-handed circularly polarized
light; and

5 the cholesteric liquid crystal polarizing film reflects right-handed circularly polarized
light.

29. The liquid crystal display according to claim 21, wherein
the cholesteric liquid crystal color filter layer reflects right-handed circularly
10 polarized light; and
the cholesteric liquid crystal polarizing film reflects left-handed circularly polarized
light.

30. The liquid crystal display according to claim 21, further comprising a
retardation film arranged on the inner surface of the second substrate.
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31. The liquid crystal display according to claim 30, further comprising a
polarizing film arranged on the retardation film.

32. The liquid crystal display according to claim 31, wherein light is linearly
20 polarizable by the polarizing film.

33. The liquid crystal display according to claim 31, further comprising a layer of liquid crystal material arranged between the inner surface of the first substrate and the polarizing film.

5 34. The liquid crystal display according to claim 21, wherein
each of the first and second substrates include red, green, and blue pixel regions;
a portion of the cholesteric liquid crystal color filter layer arranged in the red pixel
region transmits a red light;
a portion of the cholesteric liquid crystal color filter layer arranged in the green pixel
10 region transmits a green light; and
a portion of the cholesteric liquid crystal color filter layer arranged in the blue pixel
region transmits a blue light.

35. The liquid crystal display according to claim 34, wherein
15 the cholesteric liquid crystal color filter layer includes a first cholesteric liquid crystal
layer and a second cholesteric liquid crystal layer;
a portion of the first cholesteric liquid crystal layer arranged within the red pixel
region has a pitch for reflecting green light;
a portion of the second cholesteric liquid crystal layer arranged within the red pixel
20 region has a pitch for reflecting blue light;
a portion of the first cholesteric liquid crystal layer arranged within the green pixel
region has a pitch for reflecting blue light;
a portion of the second cholesteric liquid crystal layer arranged within in the green

pixel region has a pitch for reflecting red light;

a portion of the first cholesteric liquid crystal layer arranged within the blue pixel

region has a pitch for reflecting red light; and

a portion of the second cholesteric liquid crystal layer arranged within the blue pixel

5 region has a pitch for reflecting green light.